**Flare Note**

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# Conceptual Design for a Drift Cage for the 5m Drift Test

**Summary:**

A conceptual design for the drift cage for the 5 m test is presented.

It follows earlier precedent (e.g. the 50 l TPC by the Icarus group) of using PC board type electrodes. Here the electrodes are routed into large sheets of 0.031” thick copper clad non-FR4 G10.

Voltage divider resistors are soldered onto the strips.

The sheets are rolled and glued into external stabilizing rings.

The cathode plane and the chamber assembly are bolted to similar end rings.

The cage cylinder is self supporting and moves into the cryostat on four polyethylene wheels.

## *Introduction*

The Flare Collaboration is preparing a “5 m drift test” to meet several objectives:

--build a cryostat capable of providing extremely high liquid Argon purity

--provide means to measure electron lifetime accurately in very pure Argon

--build a state-of-the art high voltage system, up to 250 kV DC

--use or develop a signal readout system

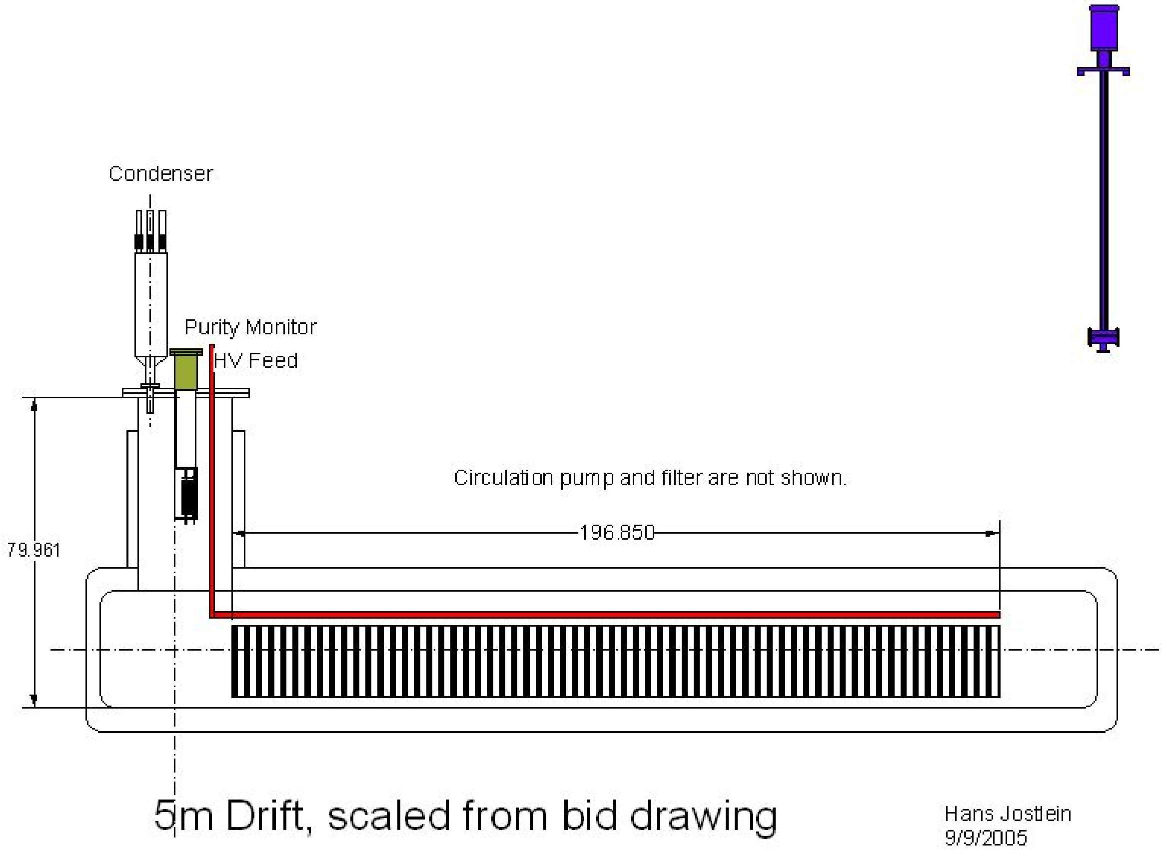
--create data to support signal filtering and automated centroid finding electronics development

--create data for future software development

## *The Cryostat and Detector Assembly*

The Cryostat has been designed and is currently out for bid solicitation.

It has room for a 5m long time projection chamber (TPC) and for support equipment such as pump, filter, purity monitor and gauges:




### *TPC Components*

The TPC consist of a cathode, which is connected to a negative HV supply, providing up to 250 kV DC. The HV is brought in through a HV feedthrough, and transported over a 1.5" SS tube form the HV feed at the "chimney" end to the "far end". The HV feed for 250 kV is yet to be designed. We did make a feedthrough that handles well in excess of 100 kV.

The signals are extracted with a wire chamber assembly at the Anode end, located under the "chimney".

There will be a collection plane and one or two induction planes. Each plane consists of many parallel bronze wires (for this test only; a large detector will have SS wires) , spaced approximately 5 mm apart. Wire planes are spaced about 6 mm apart, and their wire directions are rotated from one plane to the next. The angle may be 45, 60, or 90 degrees, yet to be decided. We expect the wire frames to be made from copper clad G10 boards, with the wires soldered on. Halogen-free flat cables carry the signals to “Signal feed throughs” and hence to preamplifiers and the data acquisition system, both outside the cryostat.

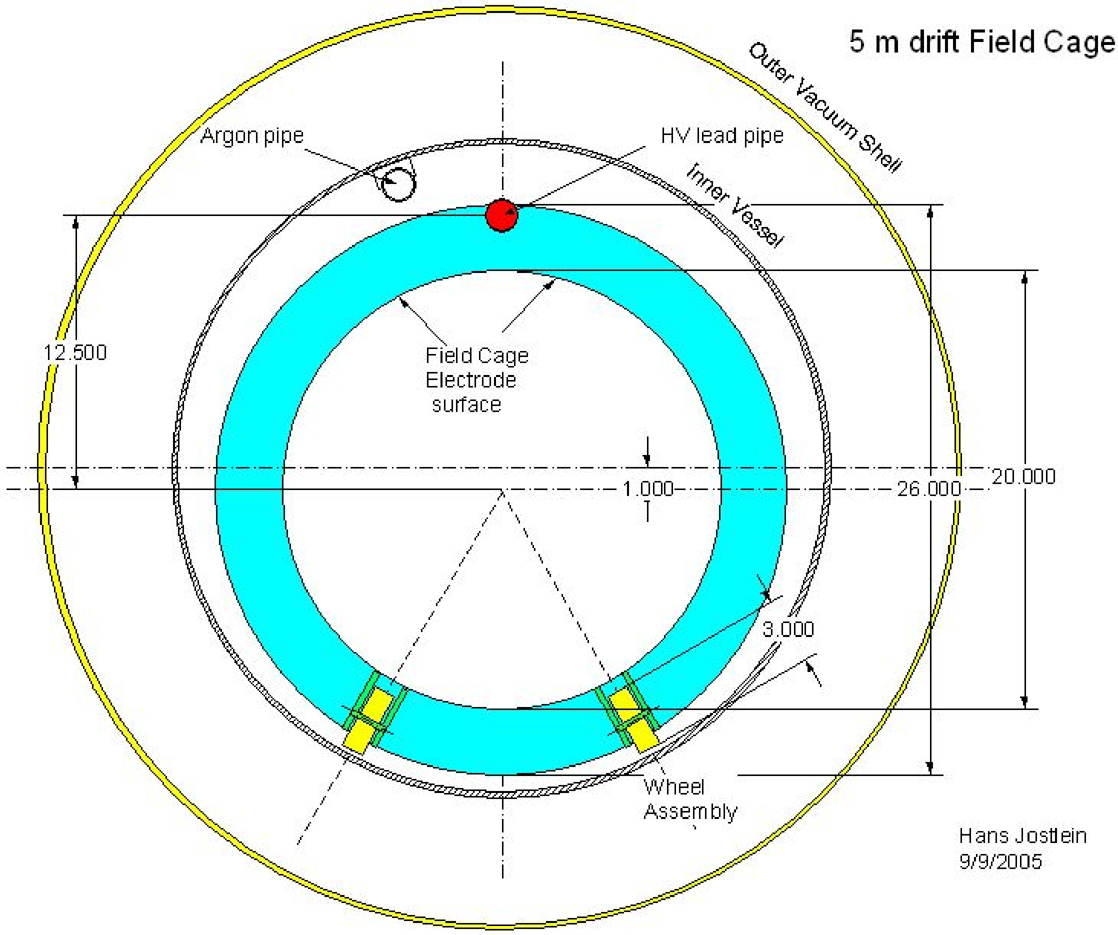
The electrons must drift from their point of origin (an ionizing track) to the chamber assembly in a straight line so as not to distort their image. This is achieved by creating a uniform electric drift field over the whole active TPC volume. Uniformity is provided by a large number of equipotential ring electrodes, with stepped potential maintained by a resistive divider chain between Cathode and anode. The drift field will be approximately 500 V/cm.

### *Design of the Field Cage*

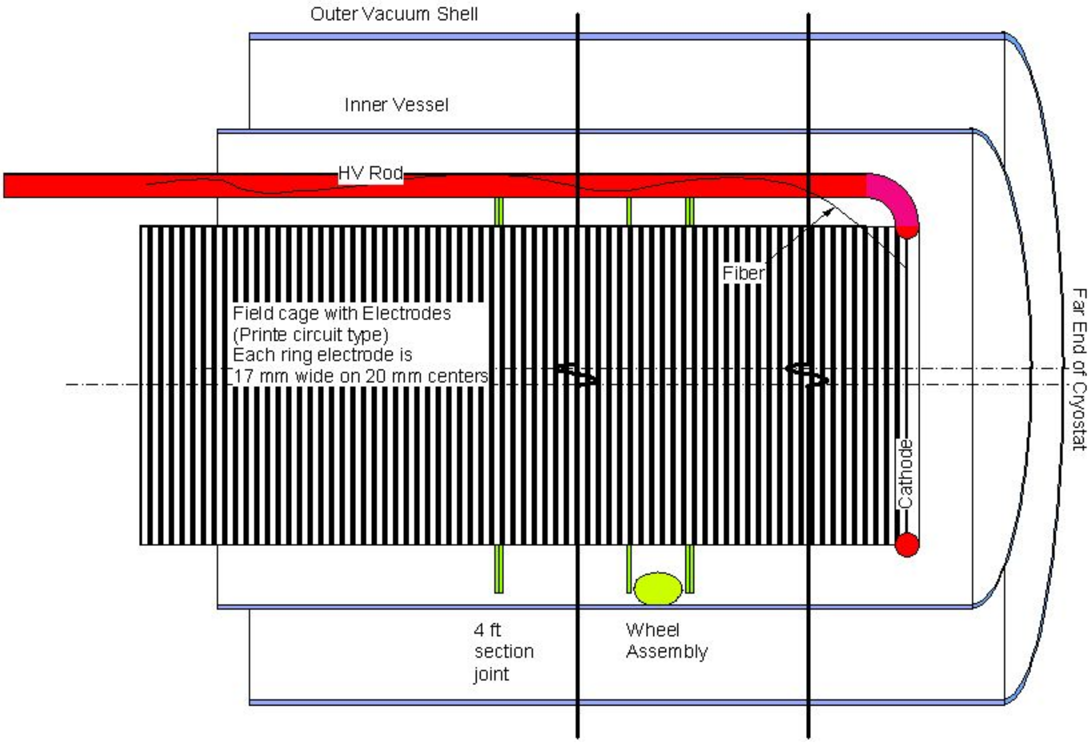
To get a very uniform electric field, the field cage should have many equipotential rings. Furthermore the gaps between the rings should be small to limit the effect of the surrounding grounded tank shell on the field.

We can meet both requirements by adapting a solution first used in the 50 liter TPC for the NOMAD experiment at CERN. The 50 liter TPC was a cube, made from six squares of G10 fiber glass epoxy boards, with a suitable electrode pattern etched in four of the panels. The remaining panels were a cathode and a chamber assembly.

For our geometry, we adapt this idea and implement it as a long cylinder with the electrode pattern on the inside. The cylinder is 5 m (16.4 ft) long, with a diameter of 20 inches. The pattern is routed into rather thin (0.031”) copper clad G10 sheets. The sheets are available only in sizes up to 4ft x 8 ft. We will cut the sheets to size 62.8” long x 4 ft wide. We will solder two chains (for redundancy) of voltage dividing resistors to the copper strips. The long edge is rolled into a 20” diameter cylinder of 4 ft length. Each cylinder is inserted into four 26” diameter G10 rings and glued to them. There are two end rings and one middle ring. Completed 4 ft sections are bolted together through their end rings. A set of Rf fingers is soldered to each end strip for connection to the next 4 ft section.




Two of the sections have two additional rings which hold a wheel assembly between them. The wheels are 1 inch wide, 3” diameter polyethylene wheels on Polysulfone shafts, and make it easy to insert the chamber assembly into the cryostat. The complete TPC is not heavy. The cage weighs about 8 kg, with another 3 kg for the chamber assembly, 1 kg for the cathode, and 4 kg for the HV rod, for a total of about 16 kg.




### *Fabrication*

The sheets can be routed in Fermilab's Lab 8 facility on the Gerber router.

The G10 rings, chamber frames, and various small parts can be routed in Lab 8 as well. The assembly can take place in Fermilab's Lab 6, using the talents of the detector group that works there.

If this method survives further scrutiny, we will have an elegant, quick, and inexpensive way to provide the TPC for the 5m drift test.